AD-A251 269

UMENTATION PAGE

	Form Approved OMB No. 0704-0188

on is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, cring and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this uring this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
May 1992	Study Report – May 1992

4. TITLE AND SUBTITLE	5. FUNDING NUMBERS
Business Process Improvement as a Component of Defense Strategy	N/A

6. AUTHOR(S)

A.E. Luke

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Information Resources Management College (IRMC) Fort Lesley McNair Washington, D.C. 20319-6000	N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Office of the Director of Defense Information 1225 Jefferson Davis Hwy Suite 910 Arlington, Va 22202-4301	CIM Report

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Available to all Government Agencies and Departments and their contractors as well as the public.	

This document has been approved for public release and sale; its distribution is unlimited.

13. ABSTRACT (Maximum 200 words)

The paper attempts to establish a framework for Corporate Information Management as a methodology for information management in the DoD and to evaluate those business process improvement concepts, such as business process redesign and functional economic analysis, as components of Defense strategy.

DTIC ELECTE JUN 0 8 1992 S A D

92-14850

14. SUBJECT TERMS		15. NUMBER OF PAGES
Corporate Information Management (CIM), business process redesign, functional economic analysis (FEA)		39
		16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

Information Resources Management College

Business Process Improvement

as a
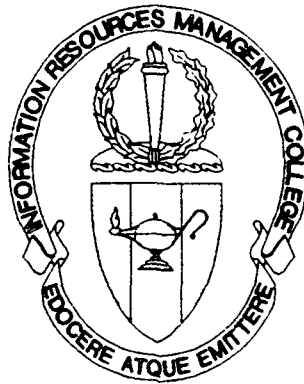
Component of Defense Strategy

by A. E. Luke

MANAGEMENT SUMMARY

Business Process Improvement

as a

Component of Defense Strategy

This paper attempts to establish a framework for Corporate Information Management as a methodology for information management in the DoD and to evaluate those business process improvement concepts, such as business process redesign and functional economic analysis, as components of Defense strategy.

"The primary objective of CIM is business process improvement. The role of information technology is supportive ...": statement by Duane Andrews, ASD (C3I) before the House Appropriations Committee, April 24, 1991.

"The essence of CIM is the idea of being ready to fight on arrival. CIM is not about payroll, logistics, inventory management -- it is about fighting. Our information systems are the backbone of our fighting capability": statement by Paul Strassmann at the IRM College, February 25, 1992.

At first reading, these two statements may appear to be, if not contradictory, not fully consistent with on another. What does redesigning processes for payroll or personnel systems have to do with command and control of the fighting force? This paper will explore those Corporate Information Management concepts for the improvement of business processes and their projection into the strategic defense arena. It will attempt to trace a line through the CIM doctrine to connect DoD's business management role with its war management and war fighting role (command and control).

There are two common command management threads which cross the spectrum of DoD information systems: (1) All systems are becoming information systems. (2) An information war (which some have said Dessert Storm was the precursor) requires the fullest possible interoperability - and interoperability will come only through systems integration.

There are also two common information management threads that cross the continuum of information systems applications from tooth to tail: (1) Managing data and the process of its conversion to information is the basis for managing information systems. (2) Managing the software development and maintenance process will determine who wins the interoperability and integration battle.

A-1

The DoD has embarked on a significant initiative to improve the functional processes that undergird both administrative and command (operational) systems. Corporate Information Management (CIM) is based on the concept that "DoD's information management decisions must be made on a business case basis" (6). That initiative has introduced Business Process Improvement as the fundamental management strategy for absorbing budget cuts under the Defense Management Review (DMR). One of the principal initiatives of a Business Process Improvement Program (BPIP) in any functional component is Business Process Redesign (BPR). "Capturing the business rules" is the end objective of Business Process Redesign. Information Engineering (IE) originated structured techniques for process and data modeling which were integrated with the information systems design and development process. The CIM emphasis on BPR has spotlighted process and data modeling as the proven method of capturing business rules and for documenting a business case. Methods and tools (IDEF) have been formally adopted which the functional user may employ for analyzing business practice and for BPR.

This is the crux of CIM. By getting control of the true functionality, through defining the business rules, we can finally get control of the run-away information systems that have grown up helter skelter to support the "perceived functionality". The logical extension of this concept beyond the business environment is to capture the "decision rules" as they relate to command and control or intelligence processes. This may some day result in a methodology for "decision process improvement." Cross-functional interoperability will then be possible through a common management paradigm for information integration.

The CIM management paradigm in context with an Integration Architecture, holds the greatest promise of achieving cross-functional integration.

BUSINESS PROCESS IMPROVEMENT

AS A

COMPONENT OF DEFENSE STRATEGY

INTRODUCTION:

Like the rest of American society, the Department of Defense is becoming heavily information driven by way of large data repositories and communications freeways which support not only its administrative operations but its military operations as well. As a result of the Corporate Information Management (CIM) strategy, the DoD has embarked on a significant initiative to improve the functional processes that undergird both administrative and command (operational) systems. Although the primary thrust of CIM is "getting the business rules right" rather than automation, this is also the CIM imperative for building (or rebuilding) DoD information systems. This paper will examine the impact of CIM as a management strategy and its application over the entire spectrum of DoD information systems - from "Tooth" to "Tail".

Corporate Information Management (CIM) is based on the concept that "DoD's information management decisions must be made on a business case basis". It has also been defined as "being ready to fight on arrival". These seemingly contradictory concepts are emerging as a single unified doctrine for information resources management in the Department of Defense.

> **"The essence of CIM is the idea of being ready to fight on arrival. CIM is not about payroll, logistics, inventory management ... it is about fighting. Our information systems are the backbone of our fighting capability"**
>
> Address by Mr.Paul Strassmann
> at IRM College, 25 February 1992

WHAT IS THE CONNECTION BETWEEN BUSINESS PROCESS IMPROVEMENT, CIM, AND INFORMATION RESOURCES MANAGEMENT (IRM)?

The original design concept for CIM as defined for the Defense Management Review by the Executive Level Group (ELG) is shown in

Figure 1. As a member of the ELG, Mr. Paul Strassmann (now the Director of Defense Information) was one of the architects of this model. It is evident that one of the central concepts of the ELG model is the use of process and data models to evaluate business practices. These models actually take two forms:

(1) The first modeling activity is conducted by the functional community and is focused on determining best business practices for improving the functional processes or activities, within constraints of economics and risk. It is done to capture the business rules from the existing functionality and perform business case analysis on the baseline process and any proposed improvements in business practices. Models are developed using a standard methodology: the Integrated Definition (IDEF) language originally developed by the Air Force. Activity Based Costing (ABC) methods have become prominent in both the private and public sectors for determining cost drivers and tracking activity costs. This is where business process redesign occurs. It is based on the premise that, after establishing and costing the existing baseline activities, an alternatives analysis is used to eliminate non-value added activities and project costs of process improvement options. A business case decision considers many factors including: investment risk analysis, discounted cash flow analysis, affordability analysis and make vs. buy analysis. However the investment decision is a return on investment decision NOT a technology decision.
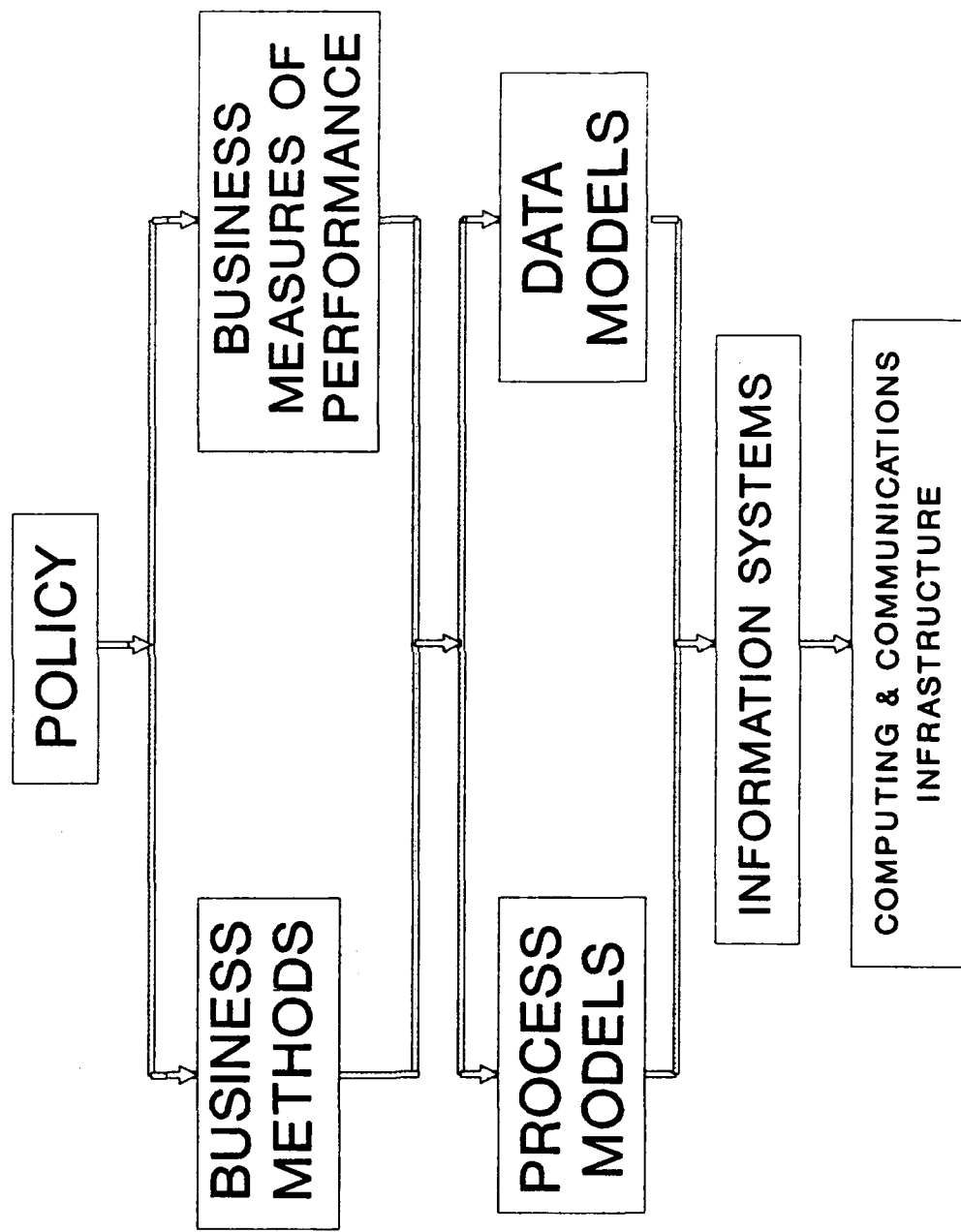
(2) The second modeling activity is conducted by the IRM community in concert with the end user. It is done through information engineering (IE) methods to develop the logical and physical models of an automated information system. (This assumes that automation is the business practice that demonstrates highest return on investment in the business case analysis.) The principal outputs of IE are also process and data models. Integrated Computer Aided Software Engineering (ICASE) tools are used to guide the model development and store the final models for the life of the information system.

The ELG model in Figure 1 has profound implications for information resources management in the DoD:

. It imposes a systematic approach to information system design and development which is based upon functional economic analysis of the business requirement.

. It links business analysis to systems analysis through process and data modeling methodology.

CORPORATE INFORMATION MANAGEMENT MODEL
Figure 1

```
                        POLICY
                          |
                          v
    BUSINESS    <---------+--------->    BUSINESS
    METHODS                             MEASURES OF
                                        PERFORMANCE
        |                                   |
        +-----------------+-----------------+
                          |
                          v
    PROCESS     <---------+--------->    DATA
    MODELS                              MODELS
        |
        v
    INFORMATION SYSTEMS
        |
        v
    COMPUTING & COMMUNICATIONS
    INFRASTRUCTURE
```

- It establishes CIM as the implementing strategy for information resources management in the DoD.

- It establishes information engineering with ICASE as the design and development strategy for business systems.

WHAT IS BUSINESS PROCESS REDESIGN?

"Every Live-Birth
  always has an Episode-Of-Healthcare
  always has an Episode-Of-Hospital-Care
  always INITIATES zero, one or many Hospital-Admission(s)
  always RESULTS-IN zero, one or many Newborn-Infants"

The foregoing is a statement taken from the Army Surgeon General's AMEDD Architecture (1). It is an excerpt from over twenty pages of business rules that were captured through IDEF activity analysis and data (business rule) modeling.

More than any other description, the above example best characterizes the end objective of Business Process Redesign - to document agreed upon business rules that reflect the functionality of the business system.

Process and data modeling techniques and the CIM policy and resulting procedures for business case development are important in a procedural sense. However, the definition, documentation and acceptance by the functional community of the business rules that underlie their business processes is the ultimate end-game.

The CIM Process Improvement Methodology for Functional Users (5) defines Business Process Redesign (BPR) as:

"The action of analyzing AS-IS activity and rule models with the intent to construct a TO-BE activity and rule model that will yield potential improvements in performance of the business process."

This analysis is accomplished in the context of a larger Business Process Improvement Program (BPIP) which is defined as:

"The application of a Business Process Redesign Methodology to one or more related business processes enabling an enterprise to improve the value of its products and services while reducing resource requirements. The results of a successful BPIP are productivity and quality improvements. A business case or action plan is a required deliverable for all BPIP actions."

These definitions provide the foundation concepts for business
process improvement and its natural extension - business process
redesign (BPR). The concept of capturing business rules using
process and data modeling techniques is not new. However, in the
past, it was the responsibility of the IRM community to build
these models as part of the design of an information system. With
the advent of Information Engineering (IE), formalized techniques
for process and data modeling became a part of that design
process. Today, these models are integral to the information
systems design and development process through the use of
Computer Assisted Software Engineering (CASE) tools. The
emphasis of CIM on Business Process Redesign has spotlighted
process (activity) and data (business rule) modeling. Methods
and tools (IDEF) have been formally adopted with which the
functional business analyst can capture the business rules which
will govern improvements in cost, quality or level of service.
This analysis should consider all available opportunities for
best business practice without being driven by information
technology considerations. Business analysis techniques are part
of an overall mosaic of methods and tools leading to the
articulation and approval of a business case and subsequent
initiation of a Business Process Improvement Program (BPIP).
Figure 2 provides an overview of the BPIP.

A comprehensive discussion of Figure 2 is beyond the scope of
this paper. However, the critical success factors for a BPIP are
listed in Appendix A. The ultimate objective of a BPIP is the
discovery, documentation and agreement by the functional
community on some fundamental statements for the business rules.
Inculcating the infrastructure for BPIP within the functional
management and operational community is essential to success. If
Total Quality Management has already taken root in a functional
community, it can be used as the vehicle for culture change in
implementing a Business Process Improvement Program. TQM already
has a process orientation which can be expanded through BPR (via
IDEF modeling) to incorporate the definition of business rules.

WHAT IS INFORMATION ENGINEERING - WHAT ROLE DOES IT PLAY?
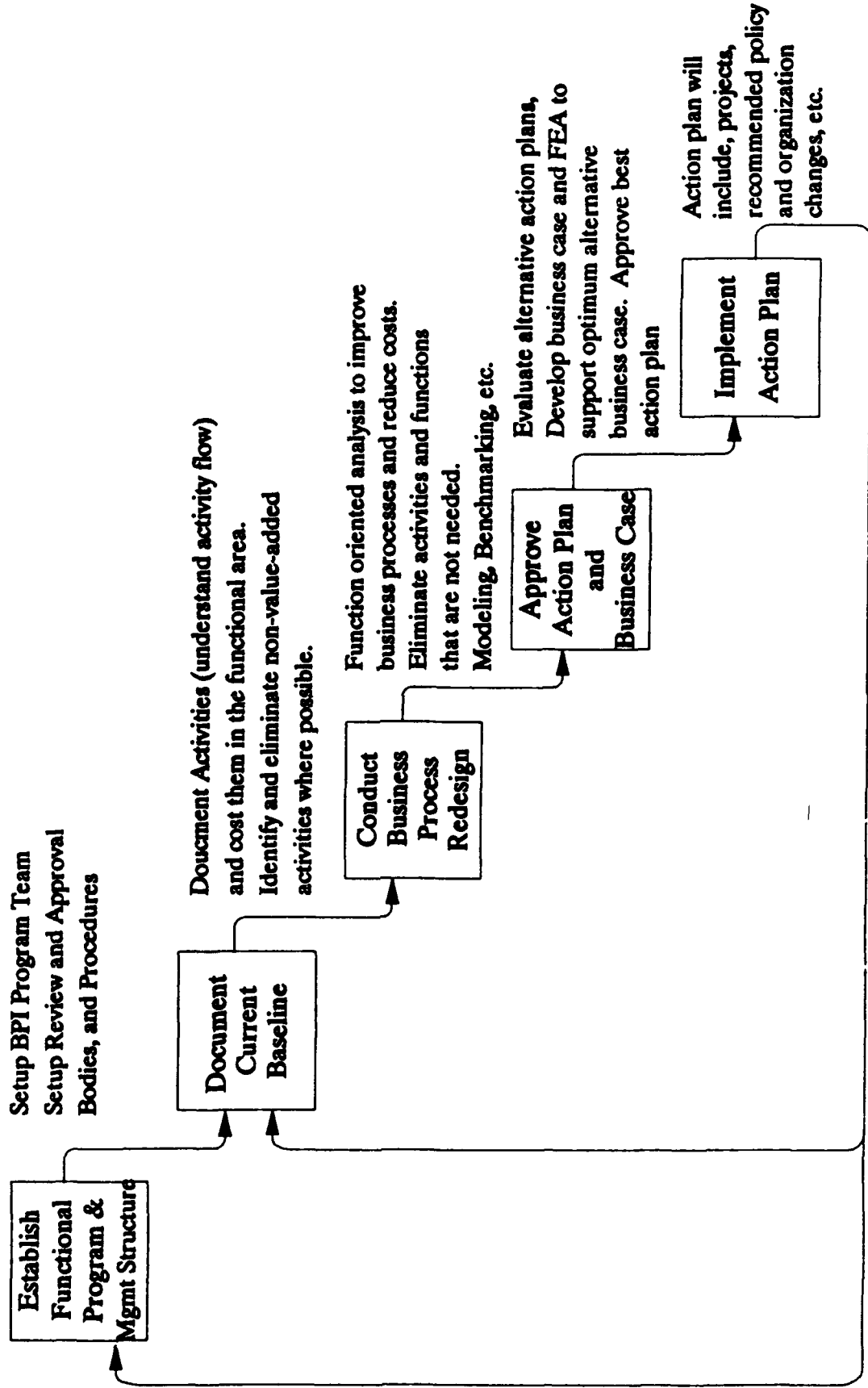
Information engineering is defined as:

> **An integrated set of formal techniques for planning,**
> **analysis, design and construction of information systems**
> **from an enterprise-wide** <u>**business**</u> **perspective.**

The following management concepts are fundamental to information
engineering:

> . **Functional requirements are separated from technical**
> **requirements.** Process modeling and data modeling are
> independent of technology infrastructure.

4

CIM Business Process Improvement Program
Figure 2

Establish Functional Program & Mgmt Structure

Setup BPI Program Team
Setup Review and Approval Bodies, and Procedures

Document Current Baseline

Doucment Activities (understand activity flow) and cost them in the functional area. Identify and eliminate non-value-added activities where possible.

Conduct Business Process Redesign

Function oriented analysis to improve business processes and reduce costs. Eliminate activities and functions that are not needed. Modeling Benchmarking, etc.

Approve Action Plan and Business Case

Evaluate alternative action plans, Develop business case and FEA to support optimum alternative business case. Approve best action plan

Implement Action Plan

Action plan will include, projects, recommended policy and organization changes, etc.

- **Logical design is separated from physical design**
  The analysis phase (logical design) precedes the design phase (physical design) so that the business rules and functional requirements are defined first - without reference to an IT solution.
- **The functional user develops and models the business methods - including the business rules.** Although the programmer/analyst may assist this process, the ultimate definition of the system requirement takes an all new form and its accuracy becomes the responsibility of the functional proponent. This is a fundamental concept of CIM.

- **Top management commitment drives the requirements** process. All levels are stakeholders in the process.

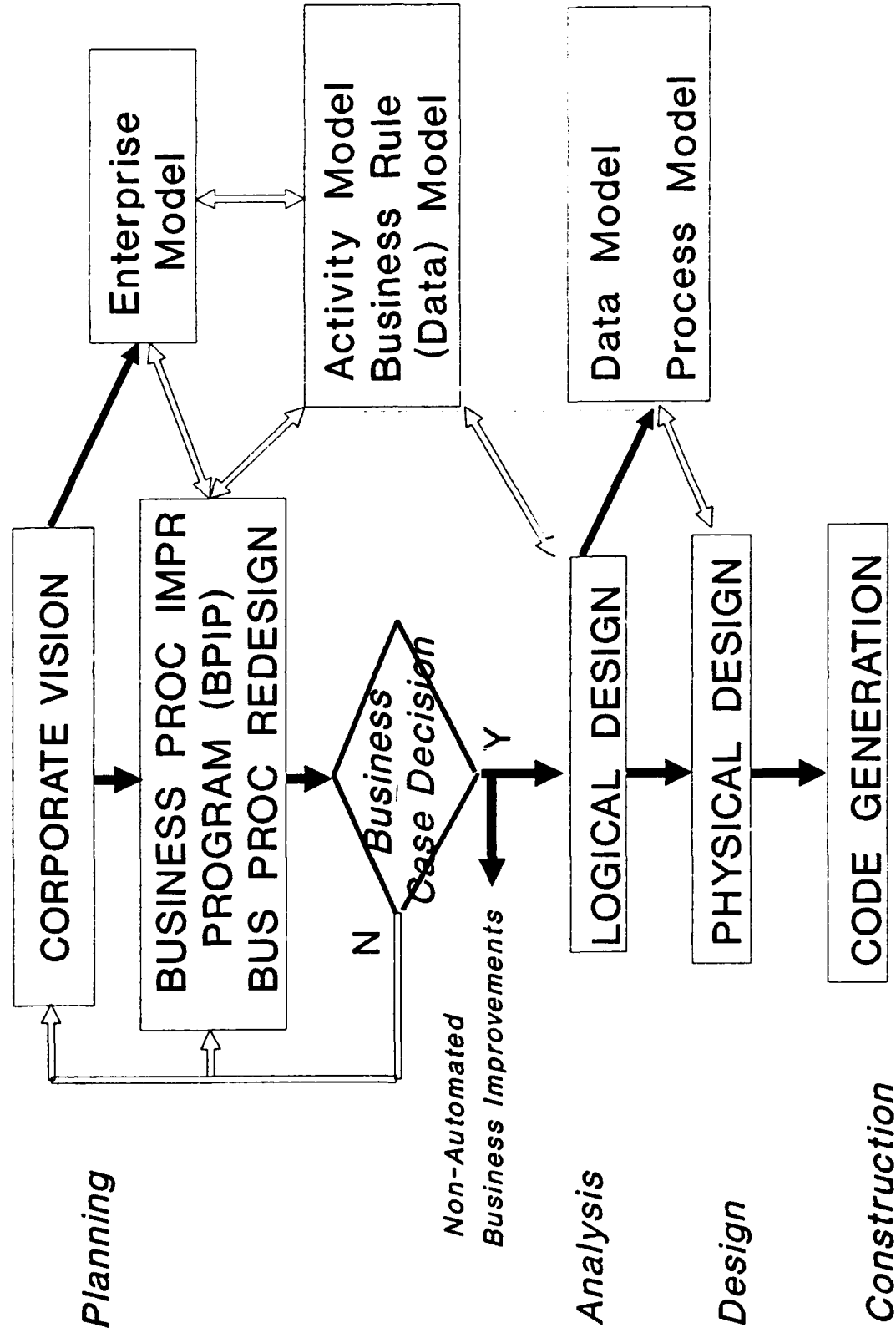- **Information Systems are built/acquired in accordance with an enterprise-wide architecture.**

Figure 3 is a high level view or "Topology of IE". It starts with a linkage to the corporate strategic vision. This is accomplished through an Enterprise Model using process and data entities to define the cross-functional relationships. As a result of this strategic analysis, corporate decisions are made to implement a Business Process Improvement Program within a functional area(s). Figure 3 also depicts the principal phases of the IE methodology: Planning, Analysis, Design, and Construction. Two of the principal products of the BPIP are Process (Activity) and Data (Business Rule) models. Once the business case decision is made (see Figure 3), these models can be imported into the logical design (Analysis Phase) for an information system. In fact, the logical design phase of IE is based upon "business analysis", NOT systems analysis. Therefore, the modeling by-products of BPR are ideally suited to provide a definition of customer requirements for the IE scenario. (Of course, this assumes that the business case produced in the BPIP has adopted automation as the best business practice for leveraging process improvements.)

Because IE data models and IDEF-based data (business rule) models have a very similar Entity-Relationship structure, the business rule models produced from BPR can be imported into the Analysis phase of IE through the repository of an Integrated CASE (ICASE) tool. However, the IDEF-based process (activity) models and IE process models are structurally quite different. Therefore, the functional customer will need to assist in the integration these models in the IE Analysis phase.

In the Design Phase, the logical system design from the Analysis Phase (along with continued functional customer input) is used as the functional requirement for the physical design. That is why

5

IE TOPOLOGY WITH BUSINESS PROCESS REDESIGN
Figure 3

Planning

- Enterprise Model
- CORPORATE VISION
- BUSINESS PROC IMPR PROGRAM (BPIP) BUS PROC REDESIGN

- Activity Model
- Business Rule (Data) Model

Analysis

- Business Case Decision
- N
- Y
- Non-Automated Business Improvements
- LOGICAL DESIGN

- Data Model
- Process Model

Design

- PHYSICAL DESIGN

Construction

- CODE GENERATION

the logical design is usually completed before the physical design (Design phase) is begun. Process and data models (business analysis) that were captured in an ICASE tool in the previous phase continue to support the systems analysis in this phase. Data base design and design level documentation are produced from symbolic ICASE products understandable to the functional customer (not machine code).

The Construction phase produces <u>computer generated source code</u> and translation to object code. Even though today's code generators produce essentially error free code, we are not relieved of the testing burden. In short, the testing function ensures that the design functionality captured in the logical and physical design actually results in the operational functionality required. <u>The management imperative is</u> that both testing and follow-on maintenance (including upgrades) are accomplished through the symbolic reference models in the ICASE tool.

The significance of the above discussion is that <u>the IE method has enabled a new concept for both development and maintenance of automated information systems</u>. Consequently, a new management paradigm for the application of CIM concepts for Business Process Improvement has arisen which has implications across the DoD.

What are the critical elements of Information Engineering?

> . **Enterprise Strategic Planning.** In order to develop enterprise-wide systems that enhance productivity and show return on investment, IE must start with strategic planning. It takes an enterprise-wide approach to identifying requirements for information systems, <u>based</u> <u>on</u> <u>business decisions</u> <u>related</u> <u>to</u> <u>return</u> <u>on</u> <u>investment</u> <u>and</u> <u>productivity improvement</u>. One of the cornerstones of the CIM Model is the development of business measures of performance on which to base those business decisions. Enterprise strategic planning usually results in a functional area analysis. This is where business process improvement enters the picture.

> . **Business Case.** Strategic systems use information technology to change the way the enterprise functions are performed. Focus is on functionally effective systems that meet enterprise-wide goals using shared data. Defining and modeling the business rules is the key IE concept. "No system is an island." First use activity models (IDEF) to build a conceptual framework for the business case. Then use IE to integrate across functional and organizational boundaries.

• **Top Executive Commitment.** Mandatory for success of CIM and IE. Key concept is to not only get corporate management involved but make them a stakeholder in the systems by linking systems objectives to corporate objectives.

• **Integrated Systems.** Driven by enterprise-wide vision and goals and integrated across functional boundaries through common data elements and data management policies. Goal oriented systems and processes force teaming between the systems and functional people to achieve corporate planning and design objectives.

• **Rapid Application Development (RAD).** Six months is the often refered to as the maximum lead time today's corporate and functional management is willing to wait for a product. Therefore, systems development and functional people must be highly productive and make use of rapid development techniques, facilitated decision making teams, and automated tools to shorten project lead times. RAD teams, backed up by ICASE tools and structured design methods allow business rules to be modeled in a design level language.

• **Logical Design Before Physical Design.** This principle demands that the system developers CANNOT build a "technical solution" before the business problem is defined by management and the functional people. Therefore, the system design becomes totally dependent upon modeling the business methods (logical model) before producing a technical design (physical model). This assumes heavy involvement from a Data Administrator and the functional user to model the relationships between corporate entities (data model) at the same time the processes are modeled by the functional user and the systems analyst (process model).

• **CASE Tool Support.** IE cannot be performed effectively without Computer Aided System Engineering (CASE) tools - but CASE tools are not a "silver bullet". Both functional and systems personnel use CASE tools to perform their tasks in executing the IE methodology. Integrated CASE (ICASE) tools provide a complete, end-to-end, knowledge-based support environment for IE. The key concept is to develop the apply ICASE tools in concert with an IE methodology that fits the corporate culture.

• **Knowledge Based.** IE is based upon an encyclopedia (or repository) concept. CASE tools center around a data encyclopedia. The encyclopedia is the central collection facility for the applications, the business rules and the data and process models (along with many other artifacts). It is the central coordination facility for integrated design and development using modeling techniques (either IDEF or ICASE).

. **Data Sharing.** This is a fundamental precept of IE and is also an integral part of the CIM management strategy using IDEF. Data sharing starts with data management policy and is implemented through as data standards program. The DoD now has a Center for Data Administration responsible for collecting standard data elements and definitions from all services and agencies.

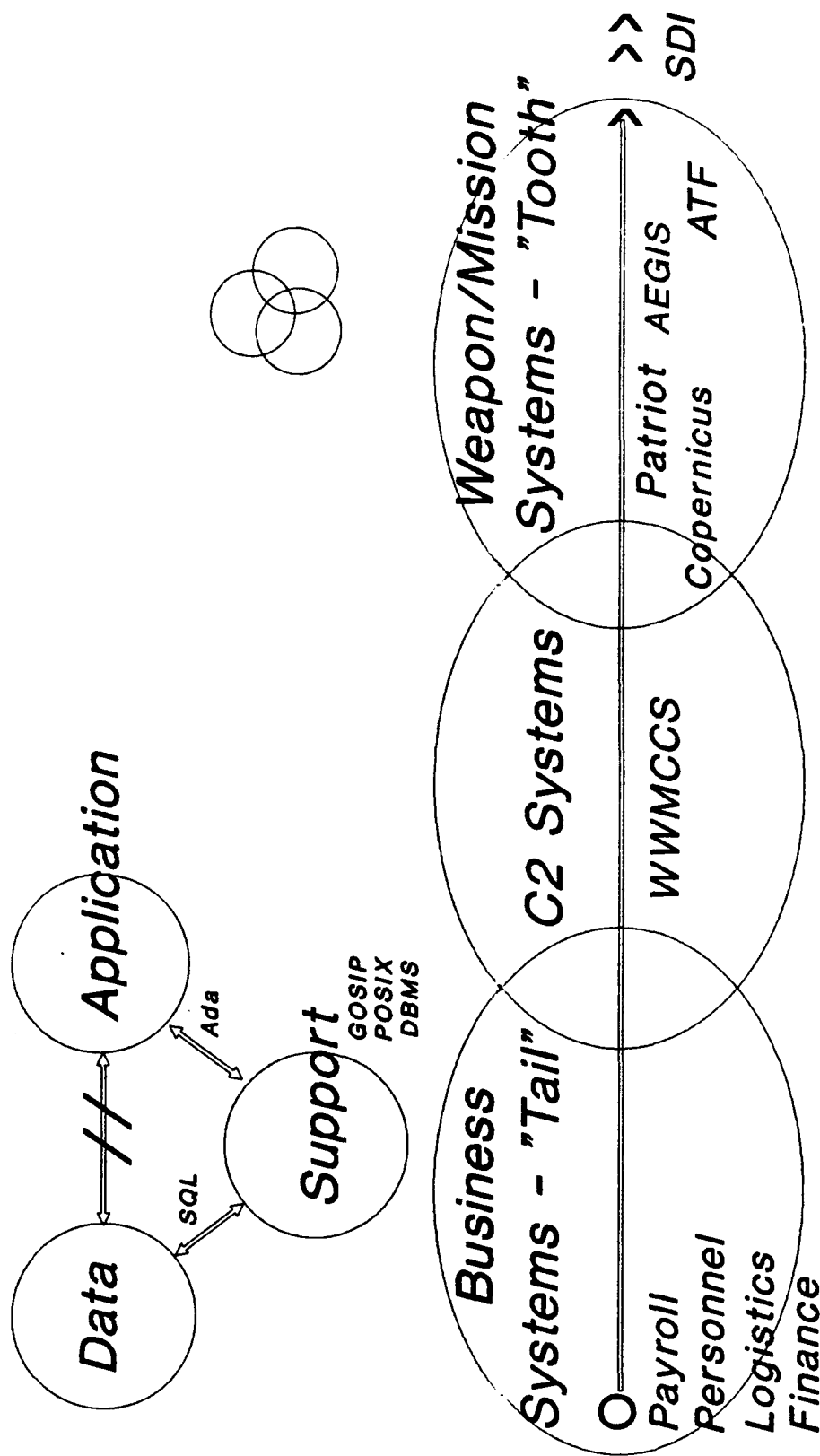## HOW DOES THE CIM STRATEGY FOR BUSINESS PROCESS IMPROVEMENT IMPACT NON-BUSINESS SYSTEMS?

CIM is an information oriented management strategy that has introduced a new management and information systems development paradigm for DoD business systems. The foundation concept for such a strategy is precept that the data component of information tends to remain relatively constant even if the mission and operational component continues to evolve. Such a management strategy is highly relevant to both the management of business functions and to the command of operational missions. In modern warfare, all systems tend to become information systems. As noted by Mackay (2):

"The whole endeavor depends on the management of information. Information is the crux, heart and linchpin of militarily useful force. Therefore, by depriving the enemy of the ability to manage and exploit information, one destroys his ability to generate as well as coordinate military force."

The CIM management strategy is, above all else, a strategy for managing and controlling information. Figure 4 shows a notional representation of the spectrum of applications within which information systems and information management are operative in the DoD. Even though there may be some abstract resemblance of mission systems to sales and competition, the private sector really does not have an analogue to the C2 and mission/weapons system environments. There are three operational environments in Figure 4: Business, Command and Control, and Weapons or Mission. Within each of these environments information systems play a strategic role. The overlaps between these environments reflect the commonality of application characteristics between operational systems (e.g. many C2 systems have large data base and transaction processing design requirements much like business systems). The implication of these overlaps to the development and integration of information systems is not yet fully understood. However, the CIM Integration Architecture discussed below provides a model for resolving the integration issues across these overlaps.

THE INFORMATION SYSTEM APPLICATION SPECTRUM

Figure 4

Application

Ada

Support — GOSIP POSIX DBMS

SQL

Data

Business Systems – "Tail"
- Payroll
- Personnel
- Logistics
- Finance

C2 Systems
- WWMCCS

Weapon/Mission Systems – "Tooth"
- Patriot AEGIS
- Copernicus ATF
- SDI

The continuum of information systems applications in Figure 4 is a model of the logical leap of faith required for military commanders to adopt the CIM doctrinal management principles. The management principles that were originally applied in the ELG Plan to the business systems ("TAIL") are now becoming the guiding principles for command and control systems as well - with a possible extension to some weapons and mission based systems (the "Tooth"). It may be easier to make a case for the projection of CIM across the application spectrum using logistics or medical systems; But what does payroll, personnel, finance and contract payment have to do with command and control of forces - much less military operations?

It has been estimated that 80 percent of the cost of the new F-22 Fighter is software. A ready comparison can be made to the makeup of the WWMCCS system and the cost of the Navy's new Copernicus system. It appears that the application of CIM doctrine to these environments is based on the concept that there are two command management threads which run the gamut of the DoD Application Spectrum: (1) All systems are becoming information systems. (2) An information war (which some have said Dessert Storm was the precursor) requires the fullest possible interoperability - and interoperability will come only through systems integration.

There are also two common information management threads that cross the continuum in Figure 4: (1) Managing data and the process of its conversion to information is the basis for managing information systems. (2) Managing the software development and maintenance process will determine who wins the interoperability and integration battle.

HOW DOES DOD MANAGE DATA UNDER CIM?

The imperatives for managing data and its conversion to information in the DoD are shown in Figure 5. Note the role of the functional community in data base stewardship (data ownership) and the concept of issuing standard data definitions as government furnished material (GFM) to contractors or DoD agencies who are building information systems. Information management rules such as those in Figure 5 are an essential characteristic of information engineering based methodologies. There are two components of data management which must be implemented under CIM: Data Administration, and Data Standards. Data Administration refers to assigning resources to manage the corporate data base. As a minimum, Data standardization refers to adopting standard data elements and attributes through the DoD Data Administraiton Center in Falls Church, Va.

DoD Data Management Guidelines
Figure 5

- Mandate single Point entry of data

- Require DoD certification of all data definitions

- Maintain data models for all applications – store in DoD Data Dictionary/Repository

- Assure single source of data origination

- Data Base stewardship defines scope of Functional role

- Issue data definitions as GFM

- Maintain data models for all applications

HOW IS IE DIFFERENTIATED FROM SOFTWARE ENGINEERING?

- "Software engineering applies structured techniques to one project.

- INFORMATION ENGINEERING APPLIES STRUCTURED, AUTOMATED TECHNIQUES TO THE ENTERPRISE AS A WHOLE.

- Software engineering is about building software.

- INFORMATION ENGINEERING IS ABOUT THE DATA THAT IS STORED AND MAINTAINED BY COMPUTERS AND THE INFORMATION THAT IS DISTILLED FROM THAT DATA.

- Software engineering refers to a set of disciplines used to specify, design, and program software.

- INFORMATION ENGINEERING REFERS TO A SET OF INTERRELATED DISCIPLINES USED TO BUILD A COMPUTERIZED ENTERPRISE BASED ON INFORMATION SYSTEMS."(7)

As a result of Corporate Information Management, supported by IE, there are two fundamental changes that take place in the corporate culture:

(1) With software engineering, the programmer analyst is responsible, by default, for modeling the business methods. **WITH IE, THE FUNCTIONAL USER SHARES CORPORATE RESPONSIBILITY FOR MODELING THE BUSINESS METHODS.**

(2) With software engineering, the information resources manager is responsible for the final system's efficiency and effectiveness. **WITH IE, THE FUNCTIONAL USER BEARS JOINT RESPONSIBILITY FOR THE NEW SYSTEM'S PRODUCTIVITY ALONG WITH THE INFORMATION RESOURCE AND CORPORATE MANAGERS.**

HOW DOES DOD MANAGE SOFTWARE DEVELOPMENT UNDER CIM?

Refer to the three circles in the upper portion of Figure 4. These represent the three software domains which are essential to any automated information system. (1) The Application domain is the software representation (model) of the real world processes and provides the operational functionality required - be it handling payroll transactions or monitoring engine heat levels on the Apache Helicopter. The application domain is the principal focus of most management activities, whether by a program manager or by GAO and Congress. However, the application domain is not sufficient by itself to fully support the application system.

10

(2)   The Support Structure Domain provides all the infrastructure support necessary for both development and operation of the application.   In recent years, standards have been developed for the Support Domain to communicate with the Application and Data domains.   The standard programming language, Ada, has been adopted to generate application software using software engineering methods.   There are also Integrated Computer Assisted Software Engineering (ICASE) tools, coupled with information engineering design and development methods which automate the generation of computer code.   Within the Support domain, GOSIP, POSIX and XWINDOWS, along with an entire suite of standards (reference model), have been adopted under CIM to provide a full complement of test, evaluation and operational support features.

(3)   Modern software engineering procedures maintain the full independence of the Data Domain from the other two domains in Figure 4.   In fact, modern information engineering design and development methods using ICASE tools negate any direct communication between the application and data domains.   The support domain communicates with the data domain, through a Data Base Management System (DBMS) using the Federal Standard, Structured Query Language (SQL).

The domain structure in Figure 4 demonstrates one of the fundamental principles of CIM: The separation of data base design from application systems design.   Those Tail systems shown in the Business environment in Figure 4 require only a loosely coupled set of software domains and communication between domains is controlled by standard support structure components.

THAT'S FINE FOR TAIL SYSTEMS BUT WHAT ABOUT TOOTH SYSTEMS?

Looking at the "Tooth" end of the spectrum in Figure 4, note that there is a much tighter coupling between the three domains cited earlier.   This is due to the real-time constrains which generally drive the design consideration for weapons and mission systems applications.   This tighter coupling does not negate the use of standards.   However, it does impose different software design considerations, and therefore, different management paradigms. For example, it is not likely that software designers for the ATF will employ a database management system to process transactions from target acquisition radar.   The data domain must be very tightly coupled with the support and application domains in order to meet real time operational requirements at mach speeds.

Ada is the language of choice for these applications and they generally employ object oriented design methods in the software engineering process.   Because these applications are characteristically driven by operational parameters which cannot

11

be supported by the loosely coupled model for "Tail" systems, "Tooth" systems are also commonly supported by manual coding techniques. These imperatives for managing systems design and development have become the drivers for significant differences in management paradigms between Tooth and Tail.

HOW DO DESIGN AND DEVELOPMENT METHODS DIFFER BETWEEN TOOTH AND TAIL?

Within the last two years there have been major advances in Integrated CASE (ICASE) tools, particularly in their ability to generate error free-code. This capability provides major productivity improvements in the software development process. However, these savings are totally eclipsed by one additional value-added opportunity: For the first time ever, DoD has the chance to get control over the software maintenance burden. Numerous studies are available to attest to the fact that maintenance of legacy systems devours some 75% to 85% of all personnel resources available for software support. The ability to make corrections or upgrades to application software without wallowing in patches upon patches at the source code level represents a major breakthrough. Integrated CASE tools make it possible to gain control over software configuration management by elevating the initial design and subsequent development and maintenance efforts to a set of symbolic (process and data) models which are maintained in the repository of the ICASE tool. When this capability is coupled with automated code generation, scarce and costly human resources that are now shackled to old code maintenance are released for more productive requirements. The Director of Defense Information has taken a lead role in a program to acquire an Integrated CASE tool set for achieving the above outcomes.

The above scenario is not all good news. For many years there was one consistent management paradigm attributed to the entire application spectrum in Figure 4:

INTERNAL MEMORY IS EXPENSIVE; EXTERNAL MEMORY IS EXPENSIVE; THEREFORE, MANDATE A PROGRAMMING LANGUAGE (Ada) WHICH WILL GIVE THE MOST EFFICIENT OPERATIONAL SYSTEM AND WILL SUPPORT SOFTWARE ENGINEERING METHODS.

As a result of the above paradigm, Ada has been mandated (and legislated) for all DoD systems development. This management paradigm is still highly relevant to a large segment of the application spectrum in Figure 4. However, with the advent of ICASE tools and automated code generation a new management paradigm has emerged for development and maintenance of Tail systems:

**THE ONLY RESOURCE WHOSE PRICE/PERFORMANCE RATIO IS
CONSISTENTLY INCREASING IS HARDWARE - THEREFORE, (IF
POSSIBLE) NEVER DO MANUAL CODING.**

Those who practice IRM in the DoD are beginning to realize that
there is a fundamental paradigm shift in management practice
somewhere along the application spectrum between Tooth and Tail.
It is presumed here that this shift occurs somewhere in the
command and control environment. Knowing and applying the
appropriate management paradigm (information engineering vs.
software engineering) is critically important to the development
of integrated information systems.

It should be stated at the outset that a healthy relationship can
and should exist between the management strategies for
Information Engineering (Tail) and Software Engineering (Tooth)
systems. One approach is not more technically nor managerially
correct than the other. When applied correctly and in the
appropriate application environment, each methodology produces
quality results. However, this is not an "I'm OK - You're OK"
situation either. <u>There is a battle going on</u> between the two
which will not be resolved by the DoD. Each is learning from and
borrowing techniques from the other. Software Engineering is
using CASE tools and process and data modeling methods borrowed
from IE. Similarly, IE is borrowing object oriented methods from
Software Engineering. This give-and-take is expected to go on as
long as both of the foregoing management paradigms continue to be
prevalent. CIM is the only management strategy which
accommodates both of these paradigms and provides both the
doctrine and the tools to make them work.

HOW DOES CIM SUPPORT THE PARADIGM SHIFT BETWEEN TOOTH AND TAIL?

The CIM initiative has been extremely perceptive in recognizing
the management paradigm shift between Tooth and Tail and has
adopted doctrinal precepts which accommodate both approaches.
Appendix B contains the CIM Information Management Doctrine for
DoD. The CIM Directions which give overall orientation to the
doctrinal concepts are the following:

- CIM systems shall evolve from function-centric, theater-
  centric and service-centric orientations towards
  decentralized systems that support Joint Task Forces.

- U.S. Military forces must possess instantly interoperable
  information systems to be able to "fight on arrival".

- To gain economy and accelerate standardization, increased emphasis shall be placed on support from centrally managed, shared resources.

Management Concepts that support those CIM Directions are the following:

- Derive information management strategies directly from war plans.

- Establish technical systems integration capabilities as a core Defense capability.

- Replace current over-emphasis on technology acquisition with functional improvements and cost reduction.

- **APPLY BUSINESS PROCESS REDESIGN AS A CONTINUOUS, INCREMENTAL AND EVOLUTIONARY PRODUCTIVITY-ENHANCEMENT PROCESS.**

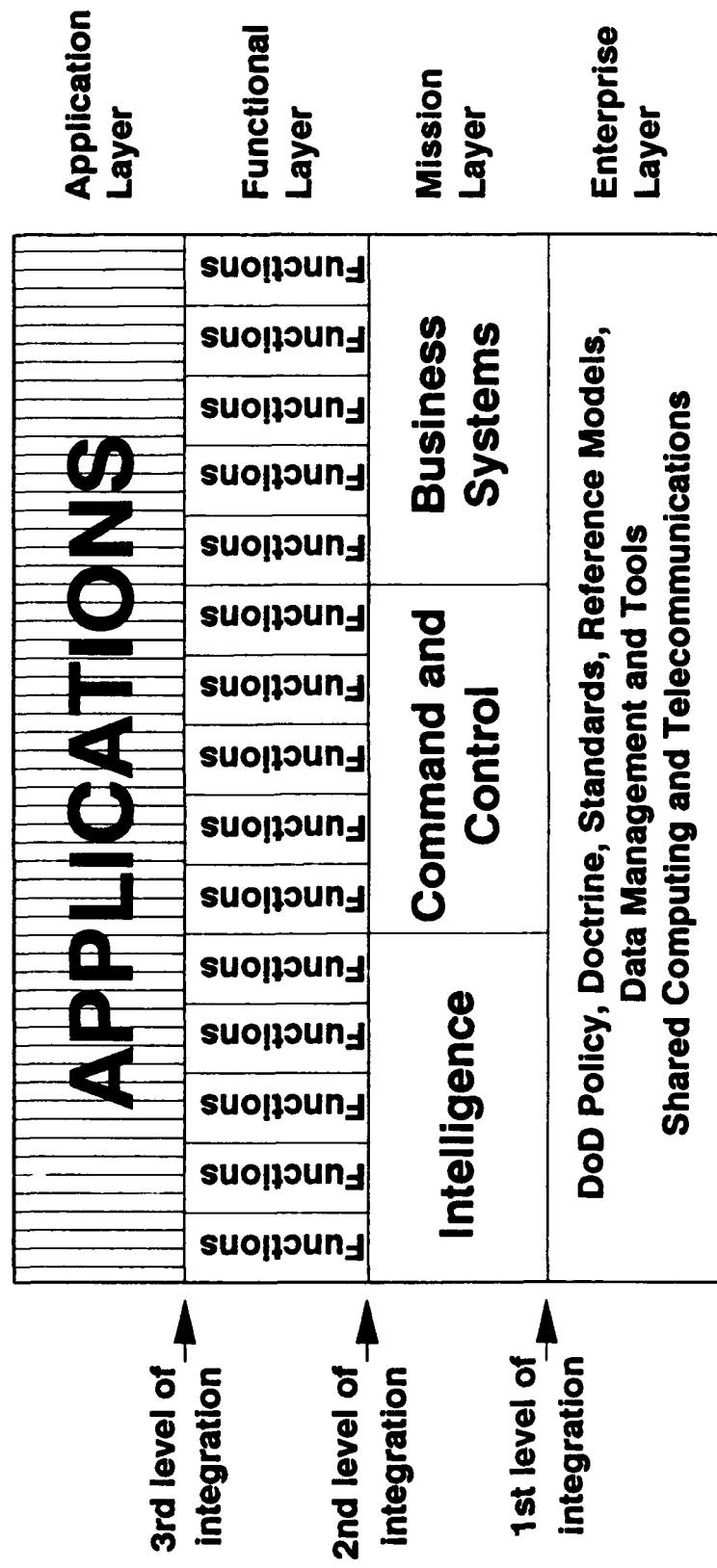## HOW CAN THE CIM MANAGEMENT DOCTRINE BE PROJECTED FROM TOOTH TO TAIL?

The CIM doctrine is guided by an Integration Architecture, see Figure 6, which defines the both the levels of integration and the interfaces required to project the CIM integration doctrine from tooth to tail. The architecture in Figure 6 is founded on a solid support structure of Policy, Doctrine, Standards, Reference Models, Data Management and Tools which are given focus and direction by the CIM doctrine in Appendix B. This "Enterprise Layer" provides the management and technical infrastructure on which to build integrated systems across the Application Spectrum in Figure 4. Included in this infrastructure is the policy, process, methods and tools to support Business Process Improvement and IE-based systems design and development.

The second layer of the CIM Integration Architecture is the Mission Layer. This layer bears a strong resemblance to the Information System Application Spectrum in Figure 4. Application systems are built upon the infrastructure of the Enterprise layer to support the requirements of the mission areas of the Mission Layer. Mission requirements at this level are based on the following CIM principles:

- Derive information management strategies directly from war plans.

14

CIM INTEGRATION ARCHITECTURE

Figure 6

Application Layer

Functional Layer

Mission Layer

Enterprise Layer

APPLICATIONS

Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions	Functions

Intelligence	Command and Control	Business Systems

DoD Policy, Doctrine, Standards, Reference Models,
Data Management and Tools
Shared Computing and Telecommunications

3rd level of integration →

2nd level of integration →

1st level of integration →

- Establish technical integration capabilities as a core Defense capability.

- Design Systems according to DoD reference models.

- Follow industry and FIPS standards - MIL standards only if necessary.

- Reserve for DoD the capability to fully support its Enterprise, Domain and Functional requirements and integration needs.

The first level of integration occurs between the Enterprise Layer and The Mission Layer - and between mission areas in the Mission Layer. This is where technology can be either an integrating force or a force divider. Therefore, the emphasis is on building systems with standards and managing data elements as the fundamental piece-parts of integration.

The Functional Layer contains the business processes that drive the information systems at both the Mission Layer and the Application Layer. <u>This is where Business Process Improvement and BPR become the linchpin to integration.</u> Capturing the business/operational rules in models makes it possible to actually integrate vertically and horizontally across the CIM Integration Architecture.

As demonstrated by Figure 7, The CIM Architecture can be mapped to the IE Topology. The DoD Enterprise Layer is the driver for corporate vision and Enterprise Modeling within the services. The Mission and Functional Layers implement the CIM doctrine for Business Process Improvement and for building information systems on a business case basis. In the Application Layer, IE methods are used to build maintainable systems from the requirements specified by the business rule models in the Functional Layer. Business processes, Command and Control, and Intelligence processes are cross-functional disciplines that bridge organizational boundaries. By defining the decision rules that implement those processes we can first understand them (and equally important control them) and use them as the integrating component between the Mission Layer and the Application layer.

At the Application layer information engineering (or software engineering) methods are used to convert the models of business processes and business rules into logical and physical models. These models become the requirements statements for the development of information systems that will support cross-functional applications.

MAPPING THE IE TOPOLOGY TO THE CIM ARCHITECTURE
Figure 7
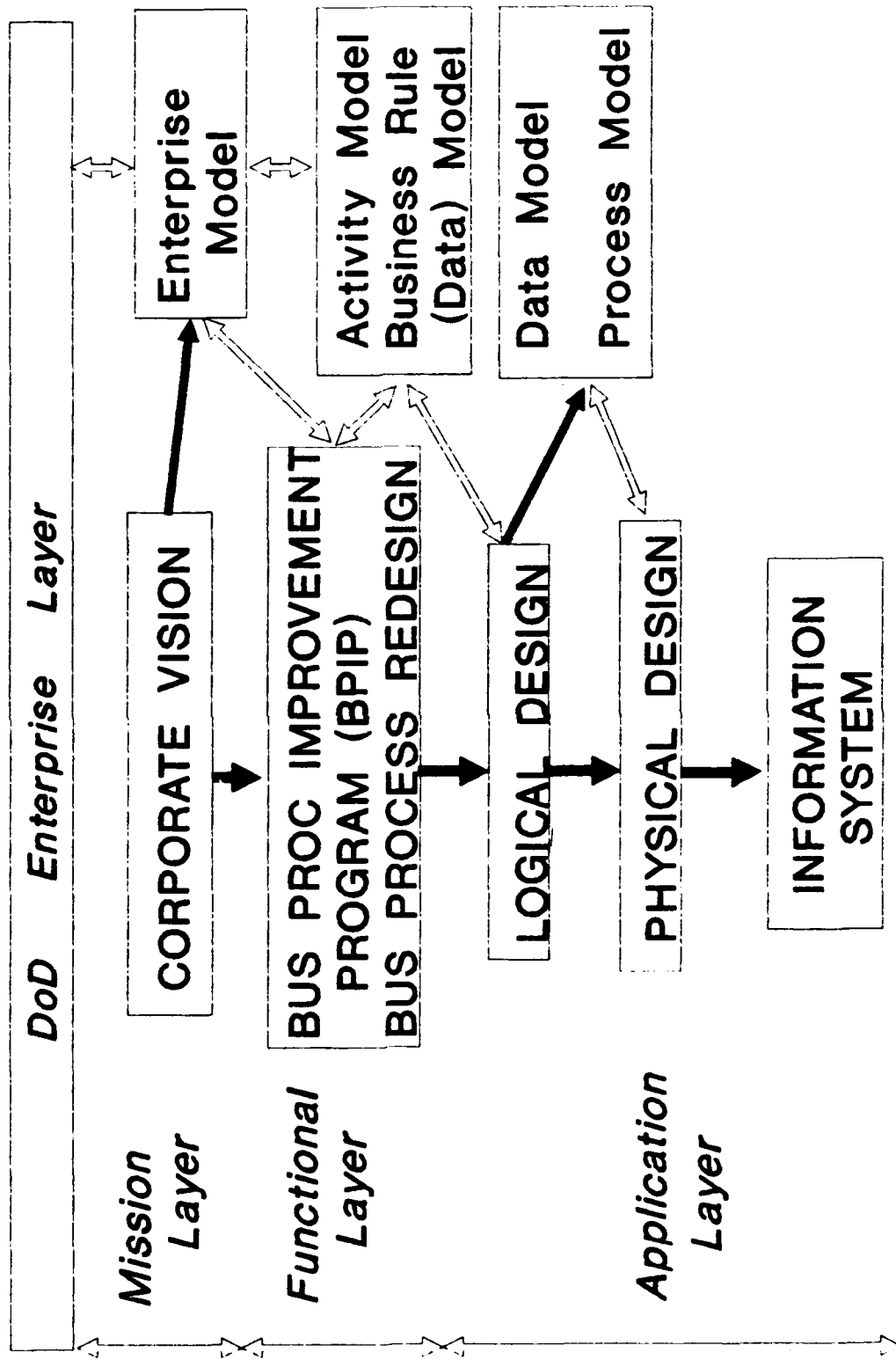
This is the crux of CIM. By getting control of the
functionality through capturing the business rules, we can
finally get control of the run-away information systems that
have grown up helter skelter to support the "perceived
functionality". The logical extension of this concept
beyond the business environment is to capture the "decision
rules" as they relate to command and control or intelligence
processes. This may someday result in a methodology for
"decision process improvement." Cross functional
interoperability can then be enabled through a common
management paradigm for information integration.

JCS Pub 2 (4) defines the "Principle of Interoperability":

"Unified action demands maximum interoperability. The
forces, units, and systems of all Services must operate
together effectively. This effectiveness is achieved in
part through interoperability, which includes collective
effort to develop joint doctrine and joint tactics,
techniques, and procedures; the development of joint plans
and the conduct of joint training; and a material
development and fielding process which is fully compatible
with and complementary to systems of all Services."

The CIM management paradigm, in context with the Integration
Architecture, holds the greatest promise of achieving this
principle.

CAN CIM-BASED INTEROPERABILITY AND INTEGRATION BECOME A UNIFYING CONCEPT?

"This is not to suggest that the action-reaction cycle of
measure and counter-measure is likely to be repealed - in
fact it is more intense than ever. What is suggested,
however, is that the ultimate winner in this contest will
not necessarily be the side with the latest piece of
electronic gadgetry. Rather, the armed forces that gather
and exploit the most critical information are likely to have
the decisive advantage."

In the above citation Allard (3) is referring to the increasing
awareness of the "Information War" concept. His book makes some
interesting observations regarding the potential future role of
the Joint Chiefs of Staff in this area. He also chronicles many
of the negative impacts of a lack of integration on the
battlefield in the case of the Joint Tactical Integrated Data
System (JTIDS). The CIM-directed approach to Business Process
Improvement - when projected from tooth to tail - is a critical

16

element of a new management context for exploiting critical information. Allard also perceives the information war of the future to have potential for changing the way we establish operational objectives:

> "Although the promise of modern command and control stops well short of completely dissipating the fog of war, it has the potential to turn night into day, achieve spans of control that can be measured in global terms, and to mass collective combat power without massing forces."

WILL THE FUNCTIONAL COMMUNITY SUPPORT THE CONCEPT?

> "Distributed information sharing can be utterly subversive of the notion of military hierarchy, which for all practical purposes considers...information lines to be identical...it may well be that command and information lines will diverge...(the) ability to move information so quickly will extend the commander's span of control in ways that revolutionize military operations itself."

The above citation (3) illustrates the contentious nature of information management and information itself as a component of Defense strategy. Although there may be some structural limits on the application of the CIM integration paradigm across the application spectrum in Figure 4, there seems to be a universal understanding of the need for interoperability - and hopefully the information integration paradigm which can be the enabler for interoperability. The IRM College may be in a position to help shape the future of this paradigm and give it meaning as a component of future DoD Strategy.

> **"The future war will be an information war. You actually win before you start shooting. It's an intelligence war, a C3I war, ... a command and control war. We have to start rethinking the IRM mission as a war prevention ... and ultimately, war winning engine - not as a COBOL payroll system or a data base system - that's in the background. The idea of fielding information technology the way we fielded muskets ... is over."**
>
> Address by Mr. Paul Strassmann to the
> IRM College, 6 June 1991.

REFERENCES

1. Office of the Surgeon General, Office Medical Department Data Architecture, STRAP Report, 1 July 1991. p. 5-15

2. Mackay, Leo S., Jr., Lieutenant U. S. Navy, "Naval Aviation, Information and the Future", Naval War College Review, Spring 1992, p.7.

3. Allard, Kenneth C., LTC, Command Control and the Common Defense. New Haven; Yale University Press, 1990.

4. U.S. Department of Defense, Joint Chiefs of Staff, JCS Publication 2. Unified Action Armed Forces (UNAAF). Washington, D.C., December 1986. p. 1-3.

5. D. Appleton Co., Inc. Corporate Information Management Process Improvement Methodology for DoD Functional Managers. Fairfax, Va., 1992

6. Andrews, Duane P., "Statement by the Honorable Duane P. Andrews, Assistant Secretary of Defense (Command, Control Communications and Intelligence) before the House Appropriations Committee, Defense Subcommittee," April 24, 1991.

7. Martin, James, and Joe Leben. "Strategic Information Planning Methodologies", Prentice Hall, 1989.

Appendix A

CRITICAL ELEMENTS OF BUSINESS PROCESS REDESIGN

1. **Leadership**

   a. Senior executive leadership and commitment

      i. Essential to bring about culture change - culture change must start at the top of the organization.

      ii. Both functional an information managers face "culture shock" and need to employee change management.

      iii. Must foster an environment of risk taking to simplify and streamline business rules and processes.

   b. Resources - willingness to commit the resources necessary for business process redesign.

      i. We have to spend resources to do business process resources. These resources include dollars and time for training, education, tools, support (facilitated decision making), etc.

   c. Recognition of competition

      i. Even in the Department of Defense, management needs to recognize there is competition.

      ii. They need to be competitive by continually improving quality of service, driving costs down, and improving timeliness, and responsiveness to internal and external customers.

   d. Customer and supplier focus

      i. This is a basic change in mind-set for both functional and information managers.

      ii. Underlies TQM as a management technique in business process redesign and systems development.

2. **Management**

   a. The functional community owns their processes.

   b. Business process redesign has a steering committee within the functional area.

   c. Business process redesign has enterprise wide acceptance - not only supported by top management but all members of the organization know their rolls and responsibilities.

   d. Focuses of business process redesign is on migration, not replacement. We will move to our new environment by a series of small steps (projects).

3. **Strategy**

   a. Business process redesign operates as a natural business process, linked to strategic planning process - it is a normal function of management.

   b. Business processes drive information system initiatives, not vice versa.

   c. Functional management will go through business process redesign as a series of incremental projects.

   d. Focuses on integration and standardization of processes and data.

      i. DoD certified data definitions in central repository provide the mechanism for functional control and stewardship of data resources.

      ii. Allows issuance of certified data attributes as standard issue to integrated information system applications and makes possible EDI and single source data entry.

e. Integrated information systems

   i. Layered Architecture Concept:

      (1) Enterprise Level. We base the enterprise level on DoD policy, doctrine, standards, reference models, and underlying architecture infrastructure.

      (2) Group Layer: supports business systems, intelligence, and command and control systems.

      (3) Functional Layer: supports operational systems.

      (4) Application Layer: supports application development and maintenance.

   ii. The government architectuer for DoD is command, control, communication, and intelligence.

   iii. Integration of DoD applications derives form shared data - NOT from data sharing.

   iv. Business process redesign before information systems redesign - Automate the right business rules by first getting the business rules right.

   v. We base the approval of the business case on risk adjusted, discounted cash flow analysis. We will consider the investment and if we can afford it.

4. **Methodology** - the methodology we use must focus on the following:

   a. Focus on business processes.

   b. Analyzes Risks and Costs.

   c. Initial steps should focus on process simplification or process elimination.

-3-

d. Uses IDEF process and data modeling methodology.

    i. IDEF is a government owned methodology. It provides process and data modeling for business process analysts - CASE tools provide a parallel capability for information systems analysis.

    ii. Provides a foundation for understanding functional process and data requirements - basis for data standardization.

    iii. Allows the application of business process improvement as a continuous, incremental and evolutionary productivity enhancement process.

e. Automation of processes is the last step in business process improvement.

f. Provides education, training and handbooks

    i. Educate mid and top level functional managers and IRM executives in the culture change of CIM and business process redesign

    ii. Train staff levels in activity analysis (modeling), activity based costing, Functional Economic Analysis, and facilitated decision making.

    iii. IRMC has the lead planning effort for business process redesign education and training

5. Use of automated tools - automated tools are essential to support business process redesign

a. Has a modeling support tool

b. Has a repository

    i. Data repository

-4-

ii. Systems repository

c. Ties to data administration and system engineering

i. DoD corporate data dictionary

ii. Integrated Computer Aided Systems Engineering (ICASE) tools

Appendix B

DoD Information Management Doctrine - Management

- Derive information management strategies directly from war plans

- Establish technical systems integration capabilities as a core Defense capability

- Replace current over-emphasis on technology acquisition by planning for total functional life-cycle costs

- Apply business re-engineering as a continuous, incremental and evolutionary productivity-enhancement process

- Charge the functional customer for information technology based on activity-based costing

- Benchmark transaction costs against commercial services

DoD Information Management Doctrine - Resources

- Evaluate functional costs, not information technology

- Reserve for DoD the capability to fully support its Enterprise, Domain and Functional requirements and integration needs

- Rely on commercial sources for delivery information all technologies except for those expressly reserved

- Justify applications on the basis of discounted cash flow analysis

- Justify shared computing and telecommunications resources on the basis of revenue from transactions

DoD Information Management Doctrine - Security

- Expect that information systems are choice war targets
- Validate each systems design for war-scenario survivability
- Evaluate survivability in terms of insurance economics
- Achieve survivability primarily through redundancy
- Support critical data bases from low-risk sites
- Escalate the enforcement of information security
- Subject network to hostile tests to identify exposures
- Control access to network entry points, especially for software management and maintenance
- Design security into hardware configurations
- Maintain central monitoring over mission-critical terminals

DoD Information Management Doctrine - Data

- Mandate single-point entry of data
- Require DoD certification of all data definitions
- Set immutable enterprise-wide data definitions
- Assure single source data origination stewardship
- Use data base stewardship to set functional boundaries
- Issue data definitions as Government Furnished Material
- Dictate the maintenance of data models for all applications
- Centralize database backup and archival functions
- Store and distribute images in standard compressed format
- Pursue electronic data interchange agreements with other agencies, suppliers and contractors

DoD Information Management Doctrine - Technology

- Use off-the-shelf hardware and software
- Lengthen technology life by continuous upgrading
- Distribute hardware and software from re-use "warehouses"
- Require single workstation for individual information needs
- Establish standardization of display interface style
- Commit to vendor-independent inter-operable systems
- Pursue a distributed client/server architecture
- Provide scalable computing capacity using microprocessors

DoD Information Management Doctrine - Standards

- Design systems according to the DoD Reference Models
- Follow industry standards, FIPS standards if industry standards not available and MIL standards only if necessary
- Define, store and distribute software objects
- Adopt a software development toolset
- Define a process and data modeling
- Specify a method for economic analysis of systems

DoD Information Management Doctrine - Design

- Pursue evolutionary and incremental systems deployment
- Design by prototype within a generally defined strategy
- Train as you fight and design (prototype) as you train
- Give customers capacity for complex inquiries
- Transfer report-generation responsibilities to customers
- Allow for rapid re-configuration of design functions
- Have business process redesign precede systems design
- Construct variety from software elements and not hardware
- Always separate software into data management, applications, reporting and output standard components

DoD Information Management Doctrine - Network

- Treat communication networks designs as inseparable from computer systems
- View the computer network as an extended workstation
- Recognize the inherent vulnerability of all networks in war and therefore place computing capacity at point of use ✓
- Integrate data, voice, graphics and video into a shared network
- Establish central management of all communication networks
- Provide, as a central service, value-added communications functions such as directory, security, information interchange and software distribution services